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Ecology and Behavior of *Acanthoscelides mundulus* in seeds of *Nissolia schottii*

(Coleoptera: Bruchidae; Leguminosae)

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For many years *Acanthoscelides mundulus* (Sharp) has been known to occur in northern Mexico and southern Arizona since Sharp (1885) described it from Guanajuato, Mexico. It has been collected in Arizona in the Coyote and Baboquivari Mountains in extreme southern Pima County (Bottimer, 1961; unpublished field notes). I did not include it in my revision of western U.S. *Acanthoscelides* (Johnson, 1970) because it has characters which are unique, and probably represents a new genus (Bottimer, 1968; J.M. Kingsolver, in litt.). After Kingsolver and Whitehead (1976) reported this species to feed in seeds of *Nissolia,* I subsequently collected ripe seeds of *Nissolia schottii* (Torr.) Gray from southern Arizona and Sonora, Mexico, and reared many *A. mundulus* from these seeds. The ecology and behavior of *A. mundulus* are reported below.

Although *A. mundulus* is not considered by some bruchid systematists to be an *Acanthoscelides,* it is similar to species in that genus and its host, *Nissolia schottii,* is in the subfamily Papilionoideae, the subfamily whose seeds are used by most species of *Acanthoscelides.* Thus, although differing from species of *Acanthoscelides,* it is similar to species in the genus both morphologically and ecologically.

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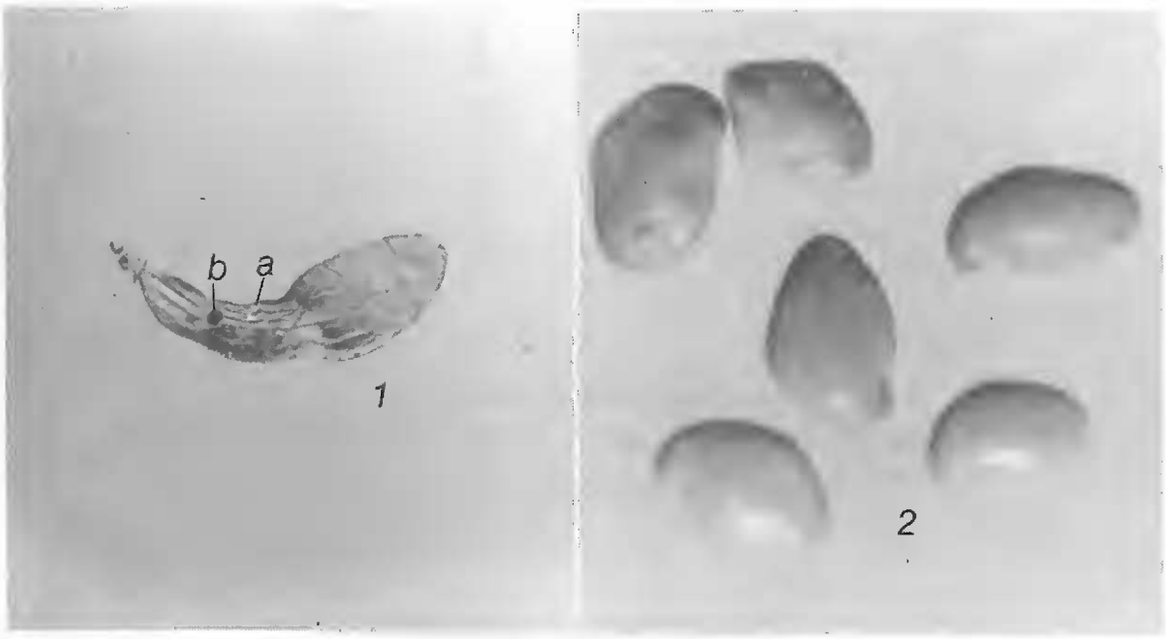

Fig. 1. Fruit of *Nissolia schottii* showing egg (a) and exit hole (b) of *Acanthoscelides mundulus*. Note large, veined wing on right side of fruit. Fig. 2. Seeds of *Nissolia schottii*. A larva of *Acanthoscelides mundulus* consumes one seed, including much of the seed coat.

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Results and Discussion

Rearing data presented in this paper were accumulated using the methods of Johnson (1970). C.D. Johnson is abbreviated CDJ.

Nissolia schottii is a fairly common herbaceous vine, with a distribution in the Rincon, Santa Catalina, Tucson, Coyote and Baboquivari Mountains, Arizona, south to Alamos, Sonora, and Baja California, Mexico. In Arizona it occurs in the Sonoran Desert Scrub — Arizona Upland Subdivision and the Plains and Desert Grassland of Lowe and Brown (1973). In Mexico I have collected it in the Plains of Sonora, the Central Gulf Coast and the Arizona Upland of Shreve and Wiggins (1964) and in the Tropical Deciduous Forest near Alamos. It grows through and over shrubs and trees. Although it grows at elevations from 2,500' to 4,000' in Arizona, I have collected it at sea level near Bahia San Carlos, Sonora. The fruits of this species are 1-, 2- or 3-seeded, flat, and have a leaflike, terminal wing often much larger than the body of the fruit (Fig. 1). A terminal wing on a legume fruit is unusual and probably is a modification for wind dispersal of the fruits. The fruits are indehiscent and when mature have elongate ridges. The pods are 22-25 mm long, the wing is 7.0-7.5 mm wide, and the

Table 1. Emergence data for *Acanthoscelides mundulus* in seeds of *Nissolia schottii*.

Culture #	Date Emerged by	number bruchids emerged	number wasps emerged
76-76	28-X-76	0	1
	29-X-76	1	0
	1-XI-76	3	1
	2-XI-76	2	0
	8-XI-76	0	3
	10-XI-76	0	1
	12-XI-76	1	3
	15-XI-76	1	2
	17-XI-76	0	1
	16-XI-76	1	1
	22-XI-76	1	0
	27-XI-76	1	1
	29-XI-76	0	1
	6-XII-76	1	0
	8-XII-76	1	0
	16-XII-76	1	0
	5-I-77	1	0
	13-I-77	2	0
82-76	28-X-76	2	7
	29-X-76	1	4
	1-XI-76	1	2
	4-XI-76	4	5
	5-XI-76	0	4
	8-XI-76	2	3
	10-XI-76	1	5
	27-XI-76	1	0
	23-XII-76	0	1
	5-I-77	1	0
120-76	12-I-77	1	0
	28-II-77	3	0
	30-III-77	1	0
	27-IV-77	3	0
124-76	20-I-77	4	0
	30-III-77	2	0
	27-IV-77	1	0
164-76	19-I-77	1	0
	24-I-77	3	0
218-76	20-I-77	3	0
	24-I-77	1	2
	17-II-77	1	0
	6-IV-77	2	0

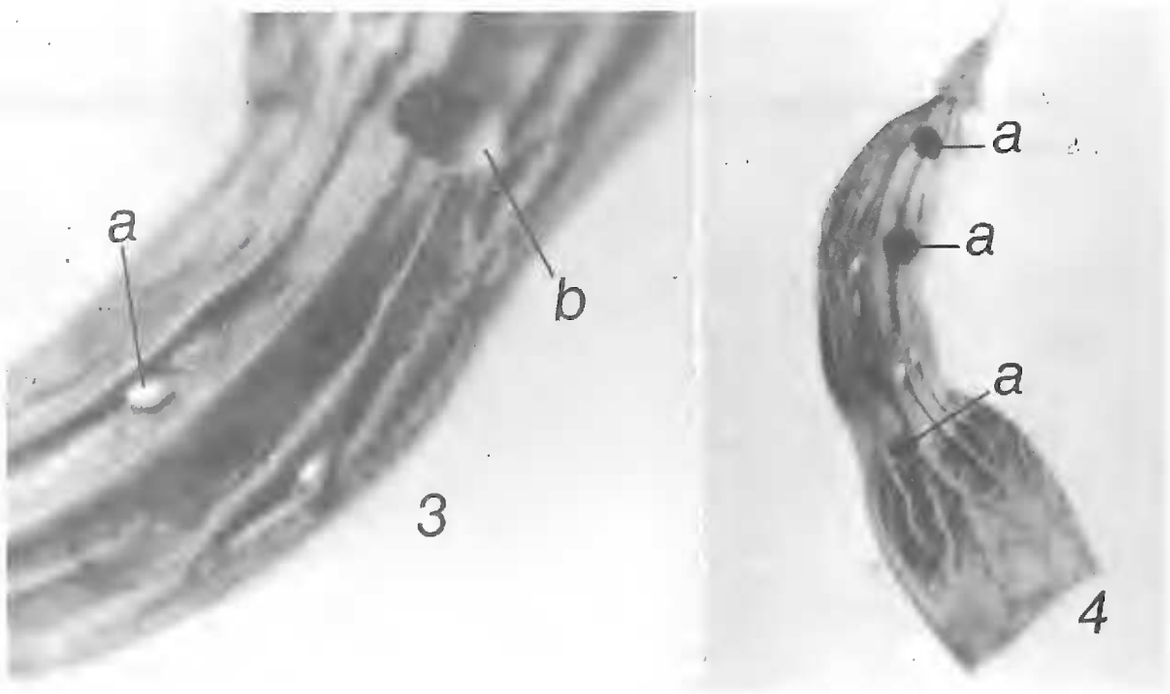

Fig. 3. Portion of a fruit of *Nissolia schottii* showing egg (a) with whitish material in it and exit hole (b) of *Acanthoscelides mundulus*. Fig. 4. Fruit of *Nissolia schottii* with exit holes (a) of *Acanthoscelides mundulus* in all three seeds.

portion of the pod containing the seeds is 3.8-4.5 mm wide x 2.5 mm Thick. The small, flat, yellowish seeds (Fig. 2) have a mean size of 3.5 x 2.5 x 1.4 mm.

Nissolia is in the tribe Hedysareae, subtribe Aeschynomeneae. The only other genus in the subtribe that is known to be a host for bruchids in northwestern Mexico is *Aeschynomene,* although both *Desmodium* (Desmodieae) and *Stylosanthes* (Stylosantheae) of the tribe Hedysareae are known hosts for bruchids in North America. (I follow the classification of the legumes by Heywood, 1971).

Adult *A. mundulus* apparently feed on pollen and nectar because I have swept them from flowers of *Acacia angustissima* and the larval host, *Nissolia schottii.* The adults apparently only need water to complete their life cycle as *A. mundulus* has completed 2 adult generations in the laboratory with only tap water supplied to them.

Of ten samples of *N. schottii* fruits collected in October and December 1976, six samples were fed upon by *A. mundulus* (Tables 1, 2, 3). The four samples not attacked were collected from Sonora, Mexico, well within the range of *A. mundulus.* All fruits in these samples were mature. One fruit in one of the samples which did not yield adult bruchids had a bruchid exit hole but none of the fruits in the four samples had bruchid eggs attached to them.

Several seeds and fruits fed upon by *A. mundulus* were examined and dissected to learn more about the life history of the bruchid. Oviposition occurs over the surface of the pod containing the seeds when *A. mundulus* is kept in culture (Figs. 1, 3) but oviposition in

Table 2. Host plants and collection localities of *Acanthoscelides mundulus*.

Old Record: Kingsolver and Whitehead, 1976: *Nissolia* seeds

New Records: Nissolia schottii (Torr.) Gray: *Arizona.* Pima Co.: ca. 3800', W side Coyote Mts., 15-X-76 (CDJ #76-76); ca. 2600', 2.3 mi S Sells, 15-X-76 (CDJ #82-76). *Mexico.* Sonora: 3 mi W San Carlos Bay, 20-XII-76 (CDJ #120-76); 1 mi W San Carlos Bay, 20-XII-76 (CDJ #124-76); 900', 13 mi NW Alamos, 23-XII-76 (CDJ #164-76); ca. 2800', 8 mi S Benjamin Hill, 28-XII-76 (CDJ #218-76).

nature usually occurs where the wing joins the fruit. The egg is glued directly to the fruit (Fig. 1a, 3a) and is surrounded by a flange of glue similar to that of *Amblycerus vitis* (Johnson and Kingsolver 1975). The egg of *A. mundulus* differs in that the entire egg is glued to the fruit surface whereas the flange of *A. vitis* is usually the only portion in contact with the fruit. The sticky flange of *A. mundulus* no doubt allows better adherence to the uneven surface of the pod valve. In culture, three to eight eggs are oviposited on the pods but only one adult emerges from each seed. As with other bruchids, cannibalism apparently occurs amongst the larvae.

The larvae enter the fruit directly beneath the egg, leaving a whitish material inside the egg chorion (Fig. 3a). A larva feeds inside one seed consuming not only the seed contents but much of the seed coat as well. It then pupates inside the seed remnants and emerges through a typical round exit hole (Fig. 1b, 3b). In seeds kept in culture it is common for each seed in a pod to be fed upon by a bruchid; one pod with three seeds even had bruchid exit holes in all three seeds (Fig. 4a).

Initial emergence of *A. mundulus* collected in Arizona commenced about two weeks after seed collection (Table 1) and continued for about two months. Those collected in Mexico followed a similar pattern but the emergence period was from six days to about 3.5 months. There are no peaks of emergence as with some other bruchids but rather emergence over a relatively long period.

The initial $\bar{x}$ infestation is a fairly low 2.9% except that culture 124-76 had 27% of its seeds attacked by *A. mundulus* (Table 3). If all seeds of *N. schottii* that were collected are considered (Table 3, all cultures), the percentage of infestation is reduced to 2.3. I hypothesize that these winged fruits are wind dispersed and that most are dispersed after the first wave of bruchids oviposit on the seeds. Thus, *N. schottii* protects its seeds by producing more seeds than the bruchids can possibly destroy prior to dispersal, another example of predator satiation. *A. mundulus* from Arizona have continued to breed in experimental cultures for two generations and these cultures are still active at this writing (1 July 1977). If the seeds are not dispersed, then these continuously breeding bruchids would most likely destroy

Table 3. Percentage infestation of seeds of *Nissolia schottii* by *Acanthoscelides mundulus*.

culture	number of seeds	number of bruchids	percent infestation	number of wasps
76-76	514	17	3.3	15
82-76	492	13	2.6	31
120-76	194	8	4.1	0
124-76	26	7	27.0	0
164-76	69	4	5.8	0
218-76	631	7	1.1	2
Total	1926	56	2.9	48
all cultures	2433	56	2.3	48

most of them. Because of the low rate of initial infestation, if the seeds are dispersed very far from the parent plant then *A. mundulus* has very little effect on the population dynamics of this plant.

Another interesting phenomenon about the *A. mundulus* — *N. schottii* association is the parasitoids attacking the bruchids. All 15 parasitoids in culture #76-76 were braconid wasps, probably *Urosigalphus bruchivorus* Crawford as were four of those in #82-76. The other 27 wasps in #82-76 were eulophids, probably *Horismenus productus* (Ashmead). Removal of the parasitoids from the cultures undoubtedly has allowed the bruchids to produce more offspring in culture. The parasitoids no doubt limit the population numbers of these bruchids in nature. Both species of parasitoids have been reported to use other bruchids as hosts (Center and Johnson, 1976).

About 1250 mature seeds of the other Arizona species of *Nissolia*, *N. wislizeni* Gray were collected from a dense stand of the plants on 6 November 1976 at Naco, Cochise County, AZ. No bruchid eggs were found on the seeds nor have adults emerged from these seeds. *A. mundulus* from #82-76 oviposited freely on these seeds and developed to maturity in them in an experimental culture.

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SCIENTIFIC NOTE

Immigration of *Phyciodes mylitta* to Vancouver Island, British Columbia (Lepidoptera: Nymphalidae)—The butterfly fauna of southern Vancouver Island, British Columbia is the most thoroughly studied of any area on the west coast of North America except the San Francisco and Los Angeles regions of California. There has been one or more resident Lepidopterist continuously from 1884 to the present, as follows: C. W. Taylor (Victoria & Nanaimo, 1884-1912); W. H. Danby (Victoria, 1890's); C. D. Green (Victoria, 1890's); E. H. Blackmore (Victoria, ?1900-1928); E. M. Anderson (Victoria, 1904-1916); G. O. Day (Duncan, 1906-1941); R. V. Harvey (Victoria, 1909-1917); G. A. Hardy (Victoria, 1924-1965); J. F. G. Clarke (Victoria, ?1925-1934); J. R. L. Jones (Duncan, 1931-1953); R. Guppy (Thetis Island, 1944-present).

In all papers up to 1962 discussing the butterflies of Vancouver Island or the province as a whole no mention was made of *Phyciodes mylitta* (Edwards) occuring on Vancouver Island. Harvey (1907, Ent. Soc. B. C. Quart. Bull. 7:2-3) made specific reference to the absence of *P. mylitta* on Vancouver Island. No specimens dated earlier than 1958 are known. Thus it would appear that *P. mylitta* is a species which has managed to immigrate to Vancouver Island in historical times.

This record of colonization of an island by a species of butterfly that was native to the adjacent continental mass appears to be unique for the Pacific Coast of North America. A possible exception is *Phoebis sennae* L. recorded from Santa Catalina Island (Meadows, 1936, Bull. S. Calif. Scad. Sci. 35:175-180). *P. sennae* was introduced to Santa Catalina Island. However, it is not known for sure if it is native to the adjacent mainland. The only other species of butterfly known to have colonized any island off the west coast in recorded history is *Pieris rapae* (L.), an introduced pest species of European origin.

Therefore it is of interest to pursue the facts concerning presence and food plants of *Phyciodes mylitta* on Vancouver Island and the adjacent mainland.

Hardy (1962, Proc. Ent. Soc. B. C. 59:14) first published records of *P. mylitta* on Vancouver Island from "the general area of Coldstream". Coldstream was a misprint of Goldstream, a favorite collecting locality of Vancouver Island Lepidopterists. Specimens of *P. mylitta* in the B.C. Provincial Museum are as follows: Goldstream, Sept. 18, 1961, G. A. Hardy (1♂); Thetis Lake, Sept. 2, 1961, G. A. Hardy (1♀). In 1962, 1963, and 1964 Hardy continued to observe *P. mylitta* including rearings (Hardy, 1964, Proc. Ent. Soc. B. C. 61:31-36).

The Pacific Forest Research Centre (Victoria) collection contains earlier records of *P. mylitta* from Vancouver Island. These specimens were all captured at Langford, a subdivision of Victoria, July 23, 1958 to July 27, 1964, D. Evans.

Guppy (1974, J. Lep. Soc. 28(3):223) published further records from Vancouver Island in 1972 and 1973. These include Duncan and Chemainus (40 miles north of Victoria). These records likely represent a northward dispersal from Victoria. J. Jones' home was at